

CLAIMS

1. A starch composition made by cooking a starch and combining the cooked starch with a polymer, the polymer containing anionic groups or potential anionic groups.

2. The starch composition of claim 1 in which the anionic groups or potential anionic groups are acidic groups or salts of acidic groups or a combination of acidic groups and salts of acidic groups.

3. The starch composition of claim 2 in which the acidic groups are one or more of the group consisting of carboxylic acid, sulfonic acid, phosphoric acid, salts of carboxylic acid, salts of sulfonic acid, and salts of phosphoric acid.

4. The starch composition of claim 1 in which the polymer is one or more of the group consisting of natural polymers, modified natural polymers, synthetic polymers, homopolymers of polyacrylates, homopolymers of polysulfonates, homopolymers of polyphosphates, copolymers of polyacrylates, copolymers of polysulfonates, and copolymers of polyphosphates.

5. The starch composition of claim 1 in which the polymer is one or more of the group consisting of polyacrylic acid, polymethacrylic acid, polystyrenesulfonic acid, carboxymethylcellulose, guar and xanthan gums, anionic and amphoteric starch, and copolymers of acrylic acid and acrylamide.

6. The starch composition of claim 1 which contains an aluminum compound prior to the cooking of the starch.

7. A furnish including the starch composition of claim 1.

8. A furnish including the starch composition of claim 1 and an inorganic colloid.

9. A furnish including the starch composition of claim 1 and an aluminum compound.

10. A starch composition made by combining a starch with a polymer, the polymer containing anionic groups or potential anionic groups, and cooking the combined starch and polymer composition.

11. The starch composition of claim 10 in which the anionic groups or potential anionic groups are acidic groups or salts of acidic groups or a combination of acidic groups and salts of acidic groups.

12. The starch composition of claim 11 in which the acidic groups are one or more of the group consisting of carboxylic acid, sulfonic acid, phosphoric acid, salts of carboxylic acid, salts of sulfonic acid, and salts of phosphoric acid.

13. The starch composition of claim 10 in which the polymer is one or more of the group consisting of natural polymers, modified natural polymers, synthetic polymers, homopolymers of polyacrylates, homopolymers of polysulfonates, homopolymers of polyphosphates, copolymers of polyacrylates, copolymers of polysulfonates, and copolymers of polyphosphates.

14. The starch composition of claim 10 in which the polymer is one or more of the group consisting of polyacrylic acid, polymethacrylic acid, polystyrenesulfonic acid, carboxymethylcellulose, guar and xanthan gums, anionic and amphoteric starch, and copolymers of acrylic acid and acrylamide.

15. The starch composition of claim 10 which contains an aluminum compound prior to the cooking of the starch.

16. A furnish including the starch composition of claim 10.
17. A furnish including the starch composition of claim 10 and an
5 inorganic colloid.
18. A furnish including the starch composition of claim 10 and an aluminum compound.
19. A dry starch composition suitable for forming an additive for a paper
10 furnish, the starch composition comprising a starch and a polymer containing anionic groups or potential anionic groups.
20. The starch composition of claim 19 in which the anionic groups or
15 potential anionic groups are acidic groups or salts of acidic groups or a combination of acidic groups and salts of acidic groups.
21. The starch composition of claim 20 in which the acidic groups are
20 one or more of the group consisting of carboxylic acid, sulfonic acid, phosphoric acid, salts of carboxylic acid, salts of sulfonic acid, and salts of phosphoric acid.
22. The starch composition of claim 19 in which the polymer is one or
more of the group consisting of natural polymers, modified natural polymers,
synthetic polymers, homopolymers of polyacrylates, homopolymers of
25 polysulfonates, homopolymers of polyphosphates, copolymers of polyacrylates,
copolymers of polysulfonates, and copolymers of polyphosphates.
23. The starch composition of claim 19 in which the polymer is one or
more of the group consisting of polyacrylic acid, polymethacrylic acid,
30 polystyrenesulfonic acid, carboxymethylcellulose, guar and xanthan gums, anionic and amphoteric starch, and copolymers of acrylic acid and acrylamide.

24. The starch composition of claim 19 which contains an aluminum compound prior to the cooking of the starch.

5 25. A furnish including the starch composition of claim 19.

26. A furnish including the starch composition of claim 19 and an inorganic colloid.

10 27. A furnish including the starch composition of claim 19 and an aluminum compound.

28. A method of making a starch composition containing a polymer, the method comprising combining a starch and a polymer to form a starch composition,
15 cooking the starch composition at a pH less than the pKa of the polymer to form a cooked starch composition, and then raising the pH of the cooked starch composition above the pKa of the polymer.

29. The method of claim 28 in which the polymer contains anionic
20 groups or potential anionic groups.

30. The method of claim 29 in which the anionic groups or potential anionic groups are acidic groups or salts of acidic groups or a combination of acidic groups and salts of acidic groups.

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31. The method of claim 30 in which the acidic groups are one or more of the group consisting of carboxylic acid, sulfonic acid, phosphoric acid, salts of carboxylic acid, salts of sulfonic acid, and salts of phosphoric acid.

30 32. The method of claim 29 in which the polymer is one or more of the group consisting of natural polymers, modified natural polymers, synthetic

polymers, homopolymers of polyacrylates, homopolymers of polysulfonates, homopolymers of polyphosphates, copolymers of polyacrylates, copolymers of polysulfonates, and copolymers of polyphosphates.

5 33. The method of claim 29 in which the polymer is one or more of the group consisting of polyacrylic acid, polymethacrylic acid, polystyrenesulfonic acid, carboxymethylcellulose, guar and xanthan gums, anionic and amphoteric starch, and copolymers of acrylic acid and acrylamide.

10 34. The method of claim 29 which contains an aluminum compound prior to the cooking of the starch.

 35. A furnish including a starch composition made according to the method of claim 29.

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 36. A furnish including a starch composition made according to the method of claim 29, and further including an inorganic colloid.

 37. A furnish including a starch composition made according to the method of claim 29, and further including an aluminum compound.

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 38. A method of making a composition suitable for adding to a paper furnish, the method comprising cooking a starch, combining the cooked starch and a polymer to form a combination having a pH lower than the pKa of the polymer, and then raising the pH of the combined starch and polymer composition to a level greater than the pKa of the polymer.

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 39. The method of claim 38 in which the polymer contains anionic groups or potential anionic groups.

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40. The method of claim 39 in which the anionic groups or potential anionic groups are acidic groups or salts of acidic groups or a combination of acidic groups and salts of acidic groups.

5 41. The method of claim 40 in which the acidic groups are one or more of the group consisting of carboxylic acid, sulfonic acid, phosphoric acid, salts of carboxylic acid, salts of sulfonic acid, and salts of phosphoric acid.

10 42. The method of claim 39 in which the polymer is one or more of the group consisting of natural polymers, modified natural polymers, synthetic polymers, homopolymers of polyacrylates, homopolymers of polysulfonates, homopolymers of polyphosphates, copolymers of polyacrylates, copolymers of polysulfonates, and copolymers of polyphosphates.

15 43. The method of claim 39 in which the polymer is one or more of the group consisting of polyacrylic acid, polymethacrylic acid, polystyrenesulfonic acid, carboxymethylcellulose, guar and xanthan gums, anionic and amphoteric starch, and copolymers of acrylic acid and acrylamide.

20 44. The method of claim 39 which contains an aluminum compound prior to the cooking of the starch.

25 45. A furnish including a starch composition made according to the method of claim 39.

 46. A furnish including a starch composition made according to the method of claim 39, and further including an inorganic colloid.

30 47. A furnish including a starch composition made according to the method of claim 39, and further including an aluminum compound.

48. A method of making a composition suitable for adding to a paper furnish, the method comprising combining a starch and a polymer, and cooking the combined starch and polymer at a pH greater than the pKa of the polymer.

5 49. The method of claim 48 in which the polymer contains anionic groups or potential anionic groups.

50. The method of claim 49 in which the anionic groups or potential anionic groups are acidic groups or salts of acidic groups or a combination of acidic groups and salts of acidic groups.
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51. The method of claim 50 in which the acidic groups are one or more of the group consisting of carboxylic acid, sulfonic acid, phosphoric acid, salts of carboxylic acid, salts of sulfonic acid, and salts of phosphoric acid.
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52. The method of claim 49 in which the polymer is one or more of the group consisting of natural polymers, modified natural polymers, synthetic polymers, homopolymers of polyacrylates, homopolymers of polysulfonates, homopolymers of polyphosphates, copolymers of polyacrylates, copolymers of polysulfonates, and copolymers of polyphosphates.
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53. The method of claim 49 in which the polymer is one or more of the group consisting of polyacrylic acid, polymethacrylic acid, polystyrenesulfonic acid, carboxymethylcellulose, guar and xanthan gums, anionic and amphoteric starch, and copolymers of acrylic acid and acrylamide.
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54. The method of claim 49 which contains an aluminum compound prior to the cooking of the starch.

30 55. A furnish including a starch composition made according to the method of claim 49.

56. A furnish including a starch composition made according to the method of claim 49, and further including an inorganic colloid.

5 57. A furnish including a starch composition made according to the method of claim 49, and further including an aluminum compound.

58. A method of making a composition suitable for adding to a paper furnish, the method comprising cooking a starch, and then combining the cooked
10 starch and a polymer, wherein the pH of the cooked starch and polymer composition is greater than the pKa of the polymer.

59. The method of claim 58 in which the polymer contains anionic groups or potential anionic groups.

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60. The method of claim 59 in which the anionic groups or potential anionic groups are acidic groups or salts of acidic groups or a combination of acidic groups and salts of acidic groups.

20 61. The method of claim 60 in which the acidic groups are one or more of the group consisting of carboxylic acid, sulfonic acid, phosphoric acid, salts of carboxylic acid, salts of sulfonic acid, and salts of phosphoric acid.

25 62. The method of claim 59 in which the polymer is one or more of the group consisting of natural polymers, modified natural polymers, synthetic polymers, homopolymers of polyacrylates, homopolymers of polysulfonates, homopolymers of polyphosphates, copolymers of polyacrylates, copolymers of polysulfonates, and copolymers of polyphosphates.

63. The method of claim 59 in which the polymer is one or more of the group consisting of polyacrylic acid, polymethacrylic acid, polystyrenesulfonic acid, carboxymethylcellulose, guar and xanthan gums, anionic and amphoteric starch, and copolymers of acrylic acid and acrylamide.

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64. The method of claim 59 which contains an aluminum compound prior to the cooking of the starch.

65. A furnish including a starch composition made according to the
10 method of claim 59.

66. A furnish including a starch composition made according to the method of claim 59, and further including an inorganic colloid.

15 67. A furnish including a starch composition made according to the method of claim 59, and further including an aluminum compound.